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INSTRUCTION MANUAL

INSTRUCTION MANUAL
FOR
OSCILLOSCOPE AMPLITUDE MODULATION
MONITOR
(For Use With FM–10 Series Mainframe Units)

MANUAL NO. 1–500783–215 (REV. A)

OAM–1

SINGER
INSTRUMENTATION

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FOR
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(For Use With FM–10 Series Mainframe Units)

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SINGER
INSTRUMENTATION

The Singer Company, Los Angeles Operation • 3211 South La Cienega Blvd., Los Angeles, Ca. 90016

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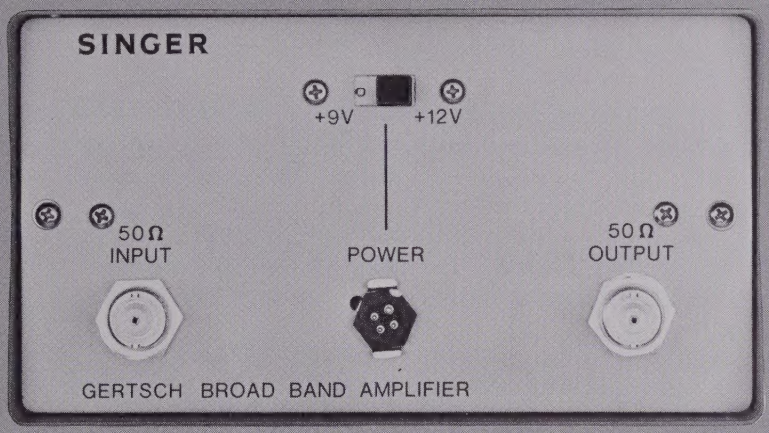
DATA BULLETIN FM-ACC-3

Broad Band Amplifier

Model BBA-1
0.1 to 512 MHz



Features

- Gives amplification of 23 dB ±4 dB from 0.1 — 512 MHz
- Offers large cost saving
- Operates from 9 or 12 VDC supply (e.g. transistor type battery)
- Operates over wide temperature range
- Uses standard 50 ohm impedance levels

Applications

- Serves as an ideal instrumentation preamplifier (counters, scopes, spectrum analyzers, etc.)
- Increases output of signal generators
- Ideal for field operation

Specifications

FREQUENCY RANGE	0.1 — 512 MHz
GAIN	23 dB ±4 dB
OUTPUT LEVEL @ 1 dB GAIN COMPRESSION	−3 dBm (approx.)
IMPEDANCE	50 ohms (nominal) input and output
OPERATING TEMPERATURE RANGE	−5°C to +50°C
POWER REQUIREMENTS	+9 VDC or +12 VDC (neg gnd) @ approx. 23 ma.
CONNECTORS	
Power	Amphenol type 126
Input and Output	BNC
DIMENSIONS	3½″ High x 6″ Wide x 3¾″ Deep
WEIGHT	Approx. 28 oz

Specifications subject to change without notice.

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Sensitive Research™ Electrical Indicating Instruments . . .	2 Years
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Chargeable repairs: If requested, an estimate of charges will be made prior to repairs. Please provide us with the following information in order to expedite the processing of your instrument:

1. Model or Type
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3. Description of trouble (1)
4. Approximate date instrument was placed in operation.
5. Approximate number of hours in use.
6. Has maintenance action been previously requested.
7. Other comments.

SELLER warrants each instrument repaired to be free from defects in material and workmanship for a period of 90 days.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken and any other relevant data.

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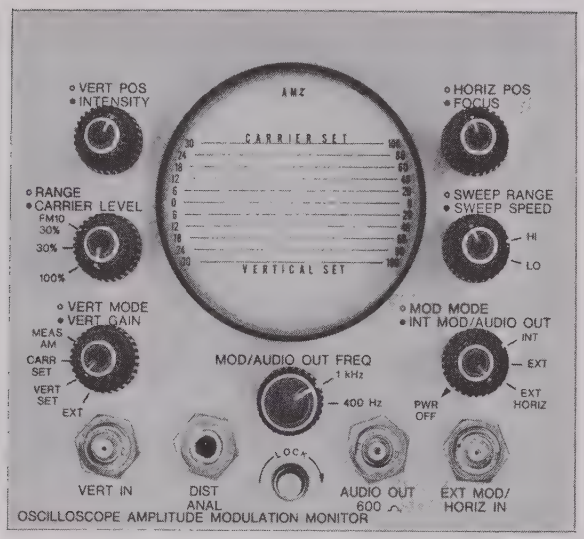


Figure 1-1. Front View

SECTION 1

GENERAL DESCRIPTION

The OAM-1 Plug-in Module is an auxiliary unit to the Singer FM-10 Series Frequency Meter/Signal Generator. The OAM-1 equips the FM-10 series to measure and generate amplitude modulation. The OAM-1 module also provide general purpose oscilloscope functions with external and internal inputs for both vertical and horizontal axis. Refer to Specifications, Table 1-1.

In the measuring mode, demodulated AM is displayed directly on an oscilloscope screen calibrated in percentage of modulation, either 30% or 100% full scale display. In the AM generating modes, modulation is also displayed on the oscilloscope and the modulation level is controlled by a potentiometer. An AM signal can be generated using internal modulation of 400 or 1000 Hertz and external modulation of from <50 Hz to >3 kHz. The modulation signal (controllable from 0 - 1 Vrms) is also available at a front panel connector.

Other facilities provided for monitoring modulation are a loudspeaker presentation of the demodulated signal (controllable in volume) and a front panel signal output jack for connection to a distortion analyzer.

TABLE 1-1. OAM-1, SPECIFICATIONS
(For use with FM-10 Series Main-frame)

1. AS AN AMPLITUDE MODULATION MONITOR		
A.	Ranges:	0 to 30%. 0 to 100% (95% max. usable).
B.	Accuracy:	±10% of full scale at 1 kHz. (1/2 division = 1/16 in. = 10%).
C.	Modulation Frequency Range:	< 50 Hz to > 3 kHz.
D.	Sensitivity:	Requires 10 mVrms ±3 dB at measure input of FM-10 series equipment.

TABLE 1-1. OAM-1, SPECIFICATIONS (Continued)

E. DIST ANAL Output:	10 mV p-p min for each % of modulation into a load impedance of 100 K or greater.
2. AS AN AMPLITUDE MODULATOR	
A. Modulation Frequencies:	
Internal:	400 Hz or 1 kHz ± 5%.
External:	<50 Hz to >3 kHz.
B. Modulation Range:	
Internal:	0 to 30% (3% max. distortion).
External:	0 to 30% (3% max. distortion). 30 to 50% (10% max. distortion).
C. Ext. Modulation Requirements:	
Input Impedance:	Nominal 50 K ohms.
Input Level:	Requires 1 v p-p for 30% ± 10% modulation.
D. Audio Output (Front Panel Output):	
Output Impedance:	600 ohms ±20%.
Level:	Adjustable 0 - 1 Vrms ±3 dB.
Distortion:	1% max.
Frequency:	Selectable 400 Hz or 1 kHz ± 5%.
3. OSCILLOSCOPE SPECIFICATIONS	
A. Vertical Amplifier	
Sensitivity:	300 mV p-p max. for full scale deflection.
Bandwidth (3 dB):	50 Hz to 30 kHz.
Input Impedance:	100K ± 20%.
Attenuator:	Continuously variable 100:1.

TABLE 1-1. OAM-1, SPECIFICATIONS (Continued)

B. Horizontal Amplifier:	
Sensitivity:	.5 v p-p max. per inch deflection.
Input Impedance:	10 meg ± 20%.
Sweep Range:	Lo = 50 Hz to 500 Hz var. Hi = 500 Hz to 5 kHz var.
Sweep Type:	Recurrent.
Sync:	Internal Automatic.
4. TEMPERATURE	
A. Range:	-5°C to +50°C.

SECTION II

INSTALLATION

PRECAUTION: Early FM-10 units have unventilated cases and will overheat when used with the OAM-1 plug-in. A vented replacement case is supplied with the OAM-1 to owners of unvented mainframes. Ensure that the unvented case has been replaced before installing the OAM-1.

2.1 To install the OAM-1 in the FM-10 mainframe, remove the blank plate covering the plug-in aperture by turning the two screws one-quarter turn CCW.

2.2 Remove the protective cover on the connector at the rear of the aperture.

2.3 Insert the OAM-1 unit flush with front panel.

2.4 Turn the locking pawl clockwise until the OAM-1 plug-in is firmly locked.

SECTION III

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

3.1.1 This section contains instructions only for operating the OAM-1 plug-in module in conjunction with the FM-10 series mainframe. Refer to the operating mainframe functions such as power supply connections, rf output control, rf signal input set-ups and beat note zeroing procedure.

3.2 OPERATING CONTROLS, INDICATORS AND CONNECTORS

3.2.1 The functions of all operating controls, indicators and connectors on the OAM-1 module are described in Table 3-1.

3.3 PRELIMINARY OSCILLOSCOPE SET-UP PROCEDURE

3.3.1 Switch on power to FM-10 mainframe.

3.3.2 Turn on power to OAM-1 module by turning internal modulation control INT MOD/AUDIO OUT clockwise. Place the AUDIO switch on the FM-10 mainframe in the OUT/MOD position. Allow approximately 1 minute for warm-up.

3.3.3 Set controls as follows:

MOD MODE	INT
SWEEP RANGE & SWEEP	As required
MOD/AUDIO OUT FREQUENCY	As required
RANGE & CARRIER LEVEL	As required
VERT GAIN	CCW
VERT MODE	As required

3.3.4 Adjust VERT POS, INTENSITY, HORIZ POS, and FOCUS controls for sharpest trace positioned on the screen.

TABLE 3-1. OPERATING CONTROLS, INDICATORS & CONNECTORS
(Keyed to Figure 3-1)

REF DES	PANEL MARKING	TYPE	FUNCTION
1	VERT POS (Outer Knob)	Variable Resistor	Controls vertical position of trace on CRT screen.
	INTENSITY (Inner Knob)	Variable Resistor	Controls brightness of CRT trace. Used with FOCUS control to obtain clear trace.
2	RANGE (Outer Knob) FM-10 30% 30% 100%	Switch, three position	FM-10 30% Position: Enables internal or external modulation of the FM-10 carrier up to 30%
			30% Position: Provides oscilloscope sensitivity for measuring of modulated carriers up to 30%.
			100% Position: Provides oscilloscope sensitivity for measuring of modulated carriers up to 100%.
	CARRIER LEVEL (Inner Knob)	Resistor, Variable	Calibrates modulation sensitivity.
3	VERT MODE (Outer Knob) MEAS AM CARR SET VERT SET EXT	Switch, four position	MEAS AM position: Modulated signal to be measured is applied to the Oscilloscope Vertical Amplifier input.
			CARRIER SET position: Carrier, minus modulation, applied to the Oscilloscope Vertical Amplifier input.
			VERT SET position: Zero signal (ground) is applied to the Oscilloscope Vertical Amplifier input.
			EXT position: In this position, the Oscilloscope Vertical Amplifier input is switched to the VERT IN connector.

TABLE 3-1. OPERATING CONTROLS, INDICATORS & CONNECTORS
(Keyed to Figure 3-1) (Continued)

REF DES	PANEL MARKING	TYPE	FUNCTION
3 Cont.	VERT GAIN (Inner Knob)	Variable Resistor	Varies level of external signal applied to the VERT IN Connector. Effective when the VERT MODE switch is in EXT position only.
4	VERT IN	Connector, BNC	VERT IN: Vertical input jack provides connection to the Oscilloscope Vertical Amplifier input when VERT MODE switch is in EXT position. External input signal level is controlled with the VERT GAIN control.
5	DIST ANAL	Jack	DIST ANAL: Demodulated audio available at this jack for output to a distortion analyzer. Also regulated +9V DC at 50 mA (max) available for FM Accessory items.
6	MOD/AUDIO OUT FREQ 1 kHz 400 Hz	Switch, two position	Controls frequency of the internal Modulation Oscillator.
7	AUDIO OUT 600Ω	Connector, BNC	400 Hz or 1 kHz signal output available at this jack. Level controlled from 0 to 1 Vrms by INT MOD/AUDIO OUT control.
8	EXT MOD/ HORIZ IN	Connector, BNC	This jack is used: 1) To provide an external modulation tone to the modulation circuit when the MOD MODE switch is in the EXT position. 2) To provide an external horizontal drive when the MOD MODE switch is in the EXT HORIZ position (No internal sync. from Oscilloscope Vertical Amplifier).

TABLE 3-1. OPERATING CONTROLS, INDICATORS & CONNECTORS
(Keyed to Figure 3-1)(Continued)

REF DES	PANEL MARKING	TYPE	FUNCTION
9	MOD MODE (Outer Knob) INT EXT EXT HORIZ	Switch, Three position	INT position: Connects the Internal Sweep Generator (synchronized by the Oscilloscope Vertical Amplifier signal) to the Oscilloscope Horizontal Amplifier input. Also connects the internal Modulation Oscillator (400 Hz or 1 kHz) output (level controlled by the INT MOD/AUDIO OUT control) to the internal AM Modulation Amplifier to internally modulate the FM-10 carrier up to 30%.
			EXT position: Connects the Internal Sweep Generator (synchronized by the Oscilloscope Vertical Amplifier signal) to the Oscilloscope Horizontal Amplifier input. Also connects the EXT MOD/HORIZ IN connector to the input of the internal AM Modulation amplifier to externally modulate the FM-10 carrier up to 30%.
			EXT HORIZ position: Connects the Oscilloscope Horizontal Amplifier to the EXT MOD/HORIZ IN connector to enable external sweep of the Oscilloscope. Also disconnects the input to the internal AM Modulation Amplifier
	INT MOD/ AUDIO OUT (Inner Knob) PWR OFF	Variable Resistor power switch	Controls internal modulation level when MOD MODE switch is in INT position. Also controls level of 400 Hz and 1 kHz tone (available at AUDIO OUT connector) from 0 to 1 Vrms. Also controls power to OAM-1 module.

3.5 USE WITH DISTORTION ANALYZER

The OAM-1 provides at the DIST ANAL jack the Recovered Audio output for distortion analyzer measurements. These measurements would most often be done in conjunction with the preceeding 3.4 paragraph on Measurement of Amplitude Modulation. If done separately, the following procedure for obtaining the recovered audio from an externally generated signal can be used.

3.5.1 Set the FM-10 dial frequency decade controls to the frequency of the transmitter. Example: Transmitter frequency -- 120.0261 MHz.

3.5.2 Offset the FM-10 frequency ±2 MHz (offset not required with the FM-10C). For above example: 118.0261 or 122.0261 MHz.

3.5.3 Couple the transmitter AM output to the FM-10 MEAS INPUT connector via the antenna provided or use the RF cable input, with an RFA-60 attenuator in the line.

3.5.4 Set the VERT MODE switch to the VERT SET position.

3.5.5 Adjust the VERT POS control to position the oscilloscope trace on the VERT SET line of the graticule.

3.5.6 Set the VERT MODE switch to the CARR SET position.

3.5.7 Adjust the transmitter coupling to the FM-10 and/or CARRIER LEVEL control to position the trace at the CARRIER SET line of the graticule.

3.5.8 Set the RANGE control for the expected modulation range (30% or 100% full scale).

3.5.9 Set the VERT MODE switch to the MEAS AM position. Recovered audio output is available at the DIST ANAL jack and also a calibrated (percent modulation) display of the signal modulation on the oscilloscope.

3.6 USE OF AN FM-10 SERIES INSTRUMENT AS AN AM MODULATED SIGNAL GENERATOR

The FM-10 series instrument with the OAM-1 module can be used as a signal generator that is internally amplitude modulated by either 400 or 1000 Hz or externally modulated with frequencies from < 50 Hz to > 3 kHz.

3.6.1 INTERNAL MODULATION

3.6.1.1 Set the FM-10 dial frequency decade controls to 12.000 MHz.

3.6.1.2 Place the 10 MHz switch on the FM-10 mainframe in the IN position.

3.6.1.3 Set the VERT MODE switch to the VERT SET position.

3.6.1.4 Adjust the VERT POS control to position the oscilloscope trace at the VERT SET line of the graticule.

3.6.1.5 Set the VERT MODE switch to the CARR SET POSITION.

3.6.1.6 Adjust the CARRIER LEVEL Control to position the oscilloscope trace at the CARRIER SET line of the graticule.

3.6.1.7 Set the RANGE control to the FM-10 30% position.

3.6.1.8 Set the VERT MODE switch to the MEAS AM position.

3.6.1.9 Set the MOD/AUDIO OUT FREQ control to the desired modulation frequency (400 to 1000 Hz) and adjust the INT MOD/AUDIO OUT control for the desired percentage modulation (30% maximum).

NOTE

The FM-10 will be modulated at the percentage set in Step 3.5.1.9 for any frequency dialed-in by the frequency selection controls.

3.6.2 EXTERNAL MODULATION

3.6.2.1 Connect the external modulating source to the EXT MOD/HORIZ IN connector (approximately 150 mV p-p for 30% modulation from 50 ohm source, < 50 Hz to >3 kHz.

3.6.2.2 Set the FM-10 dial frequency decade controls to 12.000 MHz. (For the FM-10C, set the MODE switch to the GEN MODE CAL and proceed to step 3.6.2.4).

3.6.2.3 Place the 10 MHz switch on the FM-10 mainframe in the IN position.

3.6.2.4 Set the VERT MODE switch to the VERT SET position.

3.6.2.5 Adjust the VERT POS control to position the oscilloscope trace at the VERT SET line of the graticule.

3.6.2.6 Set the VERT MODE switch to the CARR SET position.

3.6.2.7 Adjust the CARRIER LEVEL control to position the oscilloscope trace at the CARRIER SET line of the graticule.

3.6.2.8 Set the RANGE control to the FM-10 30% position.

3.6.2.9 Set the VERT MODE switch to the MEAS AM position.

3.2.6.10 Set the MOD MODE switch to the EXT position.

3.2.6.11 Set the level of the external modulating source for the desired percentage modulation (30% maximum).

NOTE

The FM-10 will be externally modulated at the percentage set in Step 3.6.2.11 for any frequency dialed-in by the frequency controls.

3.7 AUDIO TEST TONE GENERATION

Either 400 Hz or 1 kHz modulation tone developed by the FM-10/OAM-1 is available at all times at the AUDIO OUT 600 Ω connector for testing of transmitters or repeaters.

3.7.1 Connect the transmitter microphone input to the AUDIO OUTPUT 600 Ω connector.

3.7.2 Turn the MOD/AUDIO OUT FREQ switch to the desired modulation tone frequency, 400 Hz or 1 kHz, desired.

3.7.3 Turn INT MOD/AUDIO OUT control to the level desired (a maximum of 1 Vrms into 600 ohms is available).

3.7.4 The FM-10/OAM-1 is now supplying a 400 Hz or 1 kHz tone with 600 ohms output impedance.

3.8 USE AS A GENERAL PURPOSE OSCILLOSCOPE

The OAM-1 can be used as a general purpose oscilloscope with the horizontal sweep generated either internally or externally.

3.8.1 INTERNAL HORIZONTAL SWEEP

3.8.1.1 Turn the MOD MODE control to either the INT or EXT position.

3.8.1.2 Turn the VERT MODE control to the EXT position.

3.8.1.3 For maximum sensitivity turn the VERT GAIN control fully CW.

3.8.1.4 Connect the signal to be displayed on the CRT to the VERT IN connector.

NOTE

The nominal frequency response to the vertical amplifier is 50 Hz to 30 kHz.

3.8.1.5 Adjust the VERT GAIN control for suitable trace height.

3.8.1.6 Turn SWEEP RANGE switch to HI or LO position for coarse adjustment of the horizontal display.

3.8.1.7 Adjust the SWEEP SPEED control for number of cycles to be displayed.

3.8.2 EXTERNAL HORIZONTAL SWEEP

3.8.2.1 Connect an external sweep source to the EXT MOD/HORIZ IN connector (approximately 500 millivolts p to p per inch across 10 Megohms). Adjust for desired oscilloscope sweep width.

3.8.2.2 Adjust the MOD MODE control to the EXT HORIZ position.

3.8.2.3 Turn the VERT MODE control to the EXT position.

3.8.2.4 For maximum sensitivity turn the VERT GAIN control fully CW.

3.8.2.5 Connect the signal to be displayed on the CRT to the VERT IN connector.

NOTE

The nominal frequency response to the vertical amplifier is 50 Hz to 30 kHz.

3.8.2.6 Adjust the VERT GAIN control for suitable trace height.

3.8.3 X - Y MODE OF OPERATION

In some applications, it is desireable to display one signal versus another (X - Y) rather than against time (internal or external sweep).

3.8.3.1 Adjust the VERT MODE control to EXT position.

3.8.3.2 Adjust the MOD MODE control to EXT HORIZ position.

3.8.3.3 Apply the signal for X - axis display to the EXT MOD/HORIZ IN connector.

3.8.3.4 Apply the signal for Y - axis display to the VERT IN connector.

3.8.3.5 Adjust the VERT GAIN control for suitable trace height.

3.8.3.6 Adjust the X - axis signal level externally for desired trace width (approximately 300 millivolts p to p across 100 K ohms).

SECTION IV

THEORY OF OPERATION

4.1 INTRODUCTION

This section covers the principles of operation of the SINGER MODEL OAM-1 FM-10 plug-in module. The information is presented to assist the user in understanding the circuitry employed and is also useful in troubleshooting and maintenance of the equipment. The text is referenced to the Functional Block Diagram, Figure 4-1, and the Schematic Diagram, Figure 6-1, Section VI.

4.2 THEORY OF OPERATION

4.2.1 GENERAL

The OAM-1 plug-in module derives its operating power and signal input from the FM-10 mainframe via the rear connector. It carries its own power switch to permit use of the mainframe while the plug-in is switched off. High voltages for the CRT are developed within the module by a dc to dc converter operating on the +9 volts dc supplied by the mainframe. The module utilizes the 2 MHz IF output signal developed within the mainframe. There are four sub-assemblies in the OAM-1: Detector board, vertical amplifier board, horizontal amplifier board, and high voltage power supply board.

4.2.2 DETECTOR BOARD

The Detector board contains the 2 MHz IF Amplifier, AM Detector, Auxiliary Audio Amplifier, 400 Hz/1 kHz Oscillator, AM Modulation Amplifier and 400 Hz/1 kHz Driver Amplifier (see Block Diagram, Figure 4-1).

4.2.2.1 2 MHz IF Amplifier

The 2 MHz IF signal, generated in the FM-10, is applied to the OAM-1 2 MHz IF Amplifier via coaxial cable through connector P1. The 2 MHz IF Amplifier consists of three stages, (1) a tuned amplifier stage Q601, followed by (2) an integrated circuit differential amplifier V602, also tuned, and (3) a transistor emitter follower circuit that provides a low driving

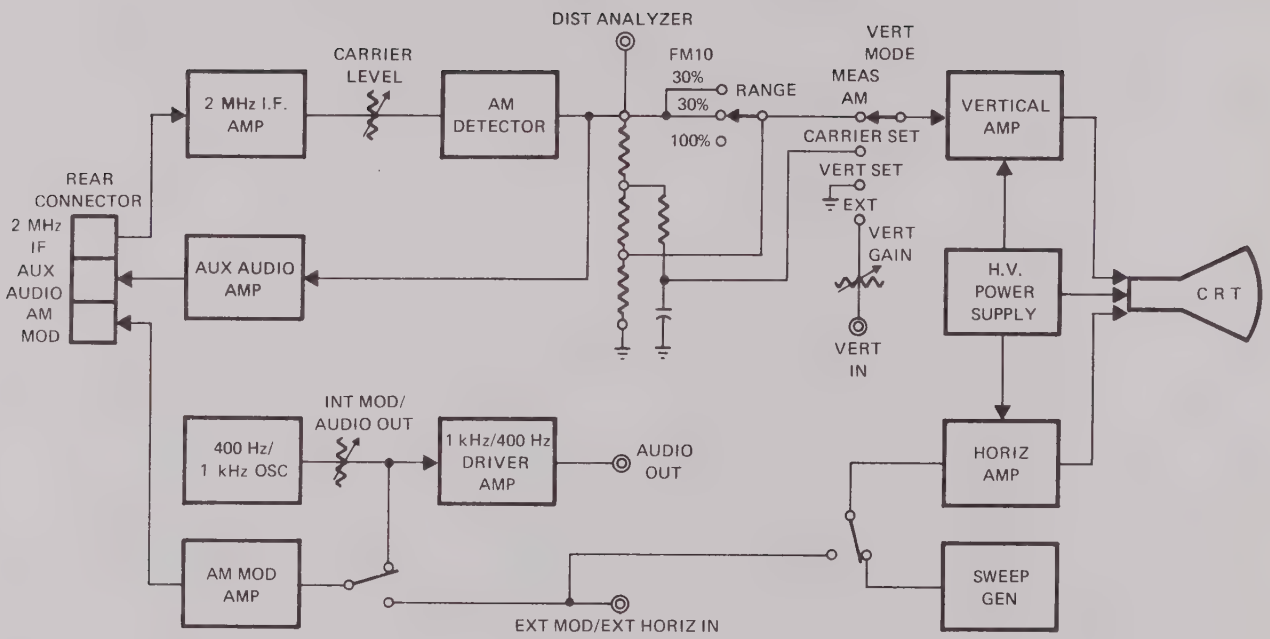


Figure 4-1. OAM-1, Block Diagram

impedance (100 ohms) to the detector circuit. The Q601 IC amplifier is AGC controlled (6 to 10 dB) to provide some output stability with fluctuations of input signal level. The gain of the IF Amplifier is also controlled by the CARRIER LEVEL potentiometer R1 which is located between Q601 and U602, ahead of the AGC loop.

4.2.2.2 AM Detector

The AM detector is made up of Q604, Q605, Q606, and Q607. This circuit constitutes an operational amplifier with 100% feedback so that the loop gain is unity. When a positive voltage appears at the base of Q604 it turns on Q604 and in turn Q606 and charges C628. As the voltage increases on C628 it is transfered by Q607 to the base of Q605. When the voltage at the base of Q605 equals the voltage at the base of Q604, Q604 is turned off, Q606 is turned off and C628 discharges through R631. The detector circuit acts as a peak envelope detector. The RC time constant of C628 and R631 is sufficiently fast that the modulation envelope is accurately followed.

The detector output is taken at the emitter of Q607. The output is a dc component with the recovered audio superimposed on it. The dc component is a positive voltage proportinate to signal level which is referred back to the voltage input of the IC amplifier - this constitutes the AGC loop. This voltage is also impressed across the precision voltage divider R656, R658, and R659.

4.2.2.3 Auxiliary Audio Amplifier

The Auxiliary Audio Amplifier supplies the recovered audio to the FM-10 audio system for monitoring. The amplifier, consisting of transistors Q608 and Q609, is effectively a dual follower with a high input impedance, a low output impedance and no voltage gain.

4.2.2.4 400 Hz/1 kHz Oscillator

The 400 and 1000 Hz oscillator is a Wein-bridge type which provides for internal modulation of the FM-10. The oscillator frequency is selected by the MOD/AUDIO OUT FREQ control, S5, which selects the feedback

adjustments R674 and R675 and the frequency adjustments R671 and R673 corresponding to frequency selected.

The output of the Wein-bridge oscillator is taken from the emitter of Q613 and across the 1 K front panel INT MOD/AUDIO OUT control. The wiper of this control is connected to the INT position of the MOD MODE switch S6-A.

4.2.2.5 AM Modulation Amplifier

When the MOD MODE switch is in the INT position, the output from the Wein-bridge oscillator is amplifier by the AM Modulation amplifier, Q616 and Q617. The output from Q617 is connected back to the mainframe and applied to the AM Modulator of the FM-10 or FM-10C. When the MOD MODE switch is in the EXT position, an external modulating signal connected to the EXT MOD/HORIZ IN connector J4 is amplifier by the AM Modulation Amplifier and applied to the AM Modulator of the FM-10 or FM-10C.

4.2.2.6 400 Hz/1 kHz Driver Amplifier

The output of the 400 Hz and 1 kHz oscillator is available at the AUDIO OUT 600 Ω receptacle J3. The tone is taken from the wiper of INT MOD/AUDIO OUT potentiometer R2 and amplifier by the 400 Hz/1 kHz Driver Amplifier Q614 and Q615 and connected directly to J3.

4.2.3 VERTICAL DEFLECTION AMPLIFIER BOARD

The signal is supplied to the Vertical Deflection amplifier board via the VERT MODE switch S2. The input stage Q100 has a very high input impedance. The vertical amplifier, consisting of Q100, Q105, Q106, and Q107 constitutes a high gain, dc - coupled amplifier with differential outputs driving the CRT vertical deflection plates. A separate amplifier Q104, supplies the vertical signal to the horizontal sweep circuit to provide internal sync. When the VERT MODE switch S2 is in the EXT position an external signal can be applied to the VERT IN connector J1 for general oscilloscope use. R3, the VERT GAIN control provides attenuation of this external signal.

4.2.4 HORIZONTAL AMPLIFIER BOARD

The horizontal amplifier board contains a sweep generator (sawtooth) and the horizontal deflection amplifier.

4.2.4.1 Sweep Generator

The sweep generator consists of Q200, Q201, and Q202. The frequency of the sawtooth generator is determined by the SWEEP RANGE and SWEEP SPEED front panel control settings. A trigger signal, supplied by Q104, is applied to the sweep generator to allow triggering from the vertical input signal.

4.2.4.2 Horizontal Deflection Amplifier

The horizontal deflection amplifier consists of Q203, Q204, and Q205. The amplifier is DC - coupled with differential outputs driving the CRT horizontal deflection plates. The horizontal amplifier is driven from the internal sweep generator when the MOD MODE switch is in either the INT or EXT position. The horizontal amplifier may be driven from an external source connected to the EXT MOD/HORIZ IN receptacle when the MOD MODE switch is in the EXT HORIZ position.

4.2.5 HIGH VOLTAGE POWER SUPPLY BOARD

The high voltage power supply is a dc to dc converter that converts the +9 volts from the FM-10 mainframe to the - 1000 volts and +300 volts required by the CRT. The converter also supplies -15 volts required by the vertical and horizontal deflection amplifiers and the Detector board.

SECTION V

MAINTENANCE

5.1 INTRODUCTION

This section contains general maintenance information, troubleshooting, and alignment.

5.2 GENERAL MAINTENANCE INFORMATION

5.2.1 Basic Requirements

Each OAM-1 module is carefully checked following alignment and calibration at the factory, and no further internal adjustments are required prior to placing the equipment in operation. In the event of a failure or malfunction, troubleshooting or adjustments should be attempted only if proper test equipment is available, and only by qualified technicians.

5.2.2 Test Equipment Required for Maintenance

The test equipment required for alignment and calibration is tabulated in Table 5-1, use the recommended type or equivalent.

5.3 MINIMUM PERFORMANCE CHECKOUT PROCEDURE

Refer to Table 5-2 for itemized procedure. The test equipment required for minimum performance checkout is included in Table 5-1.

5.3.1 Removal of OAM-1 from Case

The OAM-1 is secured to the case by five screws in the back panel. Remove the screws and slide the cover off the back.

5.3.2 Power Requirements for Alignment

All power required by the OAM-1 is supplied by the FM-10 or FM-10C.

TABLE 5-1. TEST EQUIPMENT REQUIREMENTS

DESCRIPTION	RECOMMENDED TYPE
Audio Oscillator	Hewlett-Packard, Model 200CD
AC VTVM	Hewlett-Packard, Model 400D
Frequency Counter	Hewlett-Packard, Model 5532A
Distortion Analyzer	Hewlett-Packard, Model 331A
Signal Generator	Hewlett-Packard, Model 606A
Oscilloscope	Tektronix, Model 651B
Frequency Meter	Singer, Model FM-10 or FM-10C
VOM	Simpson, Model 269
Extender Cable	Singer, Model PC-2653

TABLE 5-2. ITEMIZED PROCEDURE

PROCEDURE	ACCEPTABLE INDICATION
A. <u>To Evaluate Trace Focus and Intensity</u> Turn power switch to ON. Adjust the INTENSITY control full CW and the FOCUS control to mid-range. Set VERT MODE switch to the VERT SET position. Set the MOD MODE switch to the INT position. Allow 5 to 10 seconds for the CRT filaments to warm up and adjust the VERT POS and HORIZ POS controls until the trace is in the center of the CRT face. Readjust the FOCUS and INTENSITY controls for the sharpest trace with adequate intensity.	The trace shall be bright enough to see in a normally lit room. The FOCUS control shall be approximately at its mid-range position. The VERT POS and HORIZ POS controls shall be approximately at their mid-range positions.

TABLE 5-2. ITEMIZED PROCEDURE (Continued)

PROCEDURE	ACCEPTABLE INDICATION
B. To Evaluate Vertical and Horizontal Position Control Range	
Rotate the VERT POS and HORIZ POS controls from full CW to full CCW. Return each control to its mid-range position.	The trace shall deflect off the calibrated portion of the CRT face vertically with the VERT POS control at its extremes. The ends of the trace shall deflect horizontally to at least mid screen with the HORIZ POS control at its extremes. The trace shall be centered on the CRT face with the controls set at their approximate mid-range positions.
C. To Evaluate Sweep Range	
1. Rotate the VERT GAIN control full CW. Set the VERT MODE switch to the EXT position. Connect the Audio Oscillator and the VTVM to the VERT IN jack. Adjust the Oscillator frequency to 50 Hz and the VTVM to the 300 mV scale. Rotate the SWEEP SPEED control full CCW. Set the SWEEP RANGE switch to the LO position. Increase the audio oscillator output until the sine wave appearance on the CRT is full scale. Adjust the audio oscillator frequency for a stationary one cycle sine wave on the CRT face.	The Audio Oscillator frequency shall be less than 50 Hz or approximately 45 Hz.
2. Rotate the SWEEP SPEED control full CW. Set the SWEEP RANGE switch to the HI position. Adjust the audio oscillator frequency for a stationary one cycle sine wave on the CRT face.	The Audio Oscillator frequency shall be greater than 5000 Hz, and be spread out across the entire CRT face.
3. Rotate the SWEEP SPEED control full CCW. Adjust the Audio Oscillator frequency for a stationary one cycle sine wave on the CRT face.	The Audio Oscillator frequency shall be less than 500 Hz or approximately 450 Hz.

TABLE 5-2. ITEMIZED PROCEDURE (Continued)

PROCEDURE	ACCEPTABLE INDICATION
4. Set the SWEEP RANGE switch to the LO position. Rotate the SWEEP SPEED control to the full CW position. Adjust the Audio Oscillator frequency for a stationary one cycle sine wave.	The Audio Oscillator frequency shall be more than 500 Hz or approximately 550 Hz.
D. To Evaluate Vertical Sensitivity	
Adjust the Audio Oscillator frequency to 1 kHz. Adjust the SWEEP RANGE switch and SWEEP SPEED control for a stationary pattern on the CRT face. Adjust the output of the Audio Oscillator for full scale deflection on the CRT.	The output of the Audio Oscillator shall be 115 mVrms maximum.
E. To Evaluate Vertical Amplifier Frequency Response	
Adjust the Audio Oscillator output to obtain exactly full scale deflection on the CRT face at 1 kHz frequency. Increase the Audio Oscillator frequency to 30 kHz and note the peak-to-peak deflection on the CRT. Decrease the Audio Oscillator frequency to 50 Hz and note the peak-to-peak deflection on the CRT.	The signal appearing on the CRT face shall not have changed more than 3 dB or be less than 7 divisions peak-to-peak from 50 Hz to 30 kHz.
F. To Evaluate CARRIER LEVEL Control	
1. Connect the HP-606 Signal Generator to the FM-10 or FM-10C MEAS INPUT jack. Set the generator frequency to 25 MHz and its output to 10 mV (CW). On the FM-10; set the frequency switches to 27 MHz and the 10 MHz and AUDIO switches to the OUT positions; on the FM-10C; set the frequency switches to 25 MHz and the MODE switch to MEAS.	

TABLE 5-2. ITEMIZED PROCEDURE (Continued)

PROCEDURE	ACCEPTABLE INDICATION
2. Set the VERT MODE switch on the OAM-1 to the VERT SET position. Adjust the VERT POS control so that the trace on the CRT face is exactly on the VERTICAL SET line of the graticule. Set the VERT MODE switch to the CARR SET position. Adjust the Signal Generator frequency vernier for maximum upward deflection of the trace on the CRT face. Adjust the CARR LEVEL control so the CRT trace is exactly on the CARRIER SET line of the graticule.	
3. Decrease the Signal Generator output 3 dB from 10 mV. Increase the CARRIER LEVEL control until the CRT trace is exactly on the CARRIER SET line	The CARRIER LEVEL control shall have sufficient range to put the CRT trace on the CARRIER SET line of the graticule ± 1/2 division.
4. Increase the Signal Generator output 6 dB (10 mV + 3 dB). Decrease the CARRIER LEVEL control until the CRT trace is exactly on the CARRIER SET line	The CARRIER LEVEL control shall have sufficient range to put the CRT trace on the CARRIER SET line of the graticule ± 1/2 division.
5. Readjust the Signal Generator output to 10 mV and its frequency for maximum upward deflection of the CRT trace. Recalibrate for VERT SET and CARR SET (Step F. 2). Set VERT MODE switch to the MEAS AM position.	The CRT trace shall be on the 0 center line of the graticule. There may be a slight amount of noise appearing on the trace, but this is normal.
G. <u>To Evaluate Modulation Measurement Accuracy</u>	
1. Recalibrate as in step F. 5, if necessary. Set the Signal Generator Modulation Mode switch to the EXT position. Connect the Audio Oscillator to the EXT MOD jack of the Signal Generator and also the EXT HORIZ jack of the Oscilloscope. Set the Audio Oscillator frequency to 1 kHz and the output level to approximately 8V p-p.	E min on the trapazoid pattern on the scope CRT shall be between 2.3 and 2.0 cm (27% to 33% modulation)

TABLE 5-2. ITEMIZED PROCEDURE (Continued)

	PROCEDURE	ACCEPTABLE INDICATION
	Set the RANGE switch on the OAM-1 to the 30% position. Adjust the Modulation Amplitude control on the Signal Generator to obtain full scale deflection (30%) on the CRT face. Remove the Signal Generator cable from the FM-10 or FM-10C MEAS INPUT jack and connect it to the VERTICAL INPUT jack on the Oscilloscope. On the Oscilloscope; set the HORIZONTAL DISPLAY switch to the EXT HORIZ ATTEN X1 position, the EXT HORIZ ATTENUATOR control for approximately 5 cm horizontal deflection on the scope CRT, the TIME/CM switch to the 2 sec. position vertical sensitivity to obtain exactly 4 cm vertical deflection for E max on the trapazoid pattern on the scope CRT.	
2.	Remove the Signal Generator cable from the Vertical Input jack on the scope and reconnect it to the FM-10 or FM-10C MEAS INPUT jack. Set the RANGE switch on the OAM-1 to the 100% position. Adjust the Signal Generator Modulation Amplitude control to obtain 8 divisions (80% modulation) deflection on the graticule. The sine wave pattern on the OAM-1 CRT shall be symmetrical about the 0 center line of the graticule and be free of clipping on the peaks. Reconnect the Signal Generator cable to the Vertical Input jack on the Oscilloscope. Readjust the Vertical sensitivity to obtain 4 cm vertical deflection for E max of the trapazoid pattern on the scope CRT.	E min on the trapazoid pattern on the scope CRT shall be between 0.65 and 0.25 cms (72 to 88% modulation).

TABLE 5-2. ITEMIZED PROCEDURE (Continued)

PROCEDURE	ACCEPTABLE INDICATION
H. To Evaluate FM-10 or FM-10C (Internal) Modulation Capability and Recovered Audio Distortion	
1. FM-10; press the 10 MHz switch to the IN position. Set the frequency switches to 12 MHz. FM-10C; set MODE switch to GEN MOD CAL. Press GENERATOR MODULATION switch IN/ON. On the OAM-1; set the VERT MODE switch to the VERT SET position and position the CRT trace on the VERTICAL SET line of the graticule with the VERT POS control. Set the VERT MODE switch to the CARR SET position and position the trace on the CARRIER SET line of the graticule. With the CARRIER LEVEL control, set the RANGE switch to the FM-10 30% position. Set the MOD/AUDIO OUT FREQ switch to either the 1 kHz or 400 Hz position. Rotate the INT MOD/AUDIO OUT control to its full CW position. Set the VERT MODE switch to the MEAS AM position.	The recovered audio on the CRT shall be greater than full scale deflection.
2. Rotate the INT MOD/AUDIO OUT control for exactly full scale deflection. Connect the Distortion Analyzer to the DIST ANAL jack and calibrate it to the modulating frequency.	The measured distortion shall be less than 3% at 30% modulation.
I. To Evaluate External Modulation Capability, Frequency Response, and Recovered Audio Distortion	
Connect the Audio Oscillator and the VTVM to the OAM-1 EXT MOD/HORIZ IN jack. Set the Audio Oscillator frequency to 1 kHz and its output to approximately 400 mVrms. Set the MOD MODE switch to the EXT position. Recalibrate VERT SET and CARR SET and set the VERT MODE switch in the MEAS AM position. Readjust the Audio Oscillator output to obtain full scale deflection	The external signal level required to produce 30% modulation shall be approximately 400 mVrms. The measured distortion shall be less than 3% at 30% modulation. The recovered audio level on the CRT shall not change more than 3 dB over the frequency range of 50 Hz to 3 kHz.

TABLE 5-2. ITEMIZED PROCEDURE (Continued)

PROCEDURE	ACCEPTABLE INDICATION
(30% modulation) on the CRT. Note the VTVM reading. Calibrate the Distortion Analyzer at 1 kHz. Vary the Audio Oscillator frequency between 50 Hz and 3 kHz.	
J. <u>To Evaluate External Horizontal Sweep Capability</u>	
Set the MOD MODE switch to the EXT HORIZ position. Increase the Audio Oscillator output until the trace is spread over the diameter of the CRT face.	The amplitude required for full diameter deflection shall be approximately 400 mVrms.
K. <u>To Evaluate Audio Output Frequency, Level and Distortion</u>	
1. Connect the VTVM and the Frequency Counter to the AUDIO OUT 600 Ω jack on the OAM-1. Connect a 600 Ω resistive load across the VTVM terminals. Set the MOD/AUDIO OUT FREQ switch to the 1 kHz position. Rotate the INT MOD/AUDIO OUT control to its full CW position. Note the readings on the VTVM and the Frequency Counter. Disconnect the Counter from the AUDIO OUT 600 Ω jack and connect the Distortion Analyzer. Calibrate it at 1 kHz and note the reading.	The frequency shall be 1 kHz ±5%. The level shall be 1 Vrms ±3 dB into 600 Ω. The distortion shall be less than 1%.
2. Disconnect the Distortion Analyzer and reconnect the Counter to the AUDIO OUT 600 Ω jack. Set the MOD/AUDIO OUT FREQ switch to the 400 Hz position. Note the readings on the VTVM and the Counter. Disconnect the Counter and connect the Distortion Analyzer. Calibrate it at 400 Hz and note the reading.	The frequency shall be 400 Hz ±5%. The level shall be 1 Vrms ±3 dB into 600 Ω. The distortion shall be less than 1%.

5.4 TROUBLESHOOTING PROCEDURE

5.4.1 Visual Inspection

Remove the OAM-1 from its case and make visual inspection with power off. Proceed to electrical checkout as necessary. During the visual inspection look for burned or loose components, loose wire connections or any signs which suggest possibilities of trouble. Repair any faulty component or connection revealed by the initial inspection before proceeding to the steps below.

5.4.2 Operating Voltage Checks

Connect the OAM-1 to the FM-10 or FM-10C equipment using the Model PC-2653 Extender Cable. Energize the FM-10 equipment. Turn the INT MOD/AUDIO output control CW to turn the OAM-1 "ON".

CAUTION

High voltages are present throughout the unit and appropriate precautions should be taken while operating the unit with the cover removed.

NOTE

The following voltages to be checked are provided with no means of adjustment, consequently they are either correct or incorrect.

1. Connect the VOM between terminal E200 on the horizontal board, A4 (or E117 on the vertical board, A3) and ground. The voltage should be +9 volts ±10%, (+8.1 to +9.9V).

2. Connect the VOM between terminal E210 on the horizontal board, A4 (or E118 on the vertical board, A3) to ground. The voltage should be +300 ±10%, (+270 to +330V).

3. Connect the VOM between terminal E116 on the vertical board, A3 (or E214 on the horizontal board, A4, or E609 on the AM detector board, A1) and ground. The voltage should be -15 volts ±10%, (-13.5 to -17V).

4. Connect the VOM between the intensity control (rear pot, lower terminal with blue wire) and ground. The voltage should be -1000 volts ±10%, (-900 to -1100V).

5. Note that the neon lamp (DS-1) across the intensity control is lit.

5.5 ALIGNMENT AND ADJUSTMENT

5.5.1 Horizontal Amplifier (Board A4, Figure 5-1)

A. Location and Adjustment of the Scope Trace

1. With power applied to the OAM, turn the VERT MODE switch, S2 to "VERT SET" position and the intensity control full CW.

2. Turn the horizontal and vertical position controls (R8 and R6 respectively) to mid-range, set the MOD MODE switch, S6 to the "INT" position.

3. The trace should now be present on the scope. If it is not, vary the vertical and horizontal positioning controls until the trace is secured.

4. Center the trace and adjust the intensity and focus controls to sharpen the trace.

5. Adjust the astigmatism control (A4-R217) for maximum sharpness of the trace.

6. Adjust A4-R13 (GAIN SET) to increase or decrease the width of the trace on the scope face.

B Sweep Range Adjustment

1. Turn the VERTICAL GAIN control (R3) full CW, turn the VERT MODE switch to the "EXT" position.

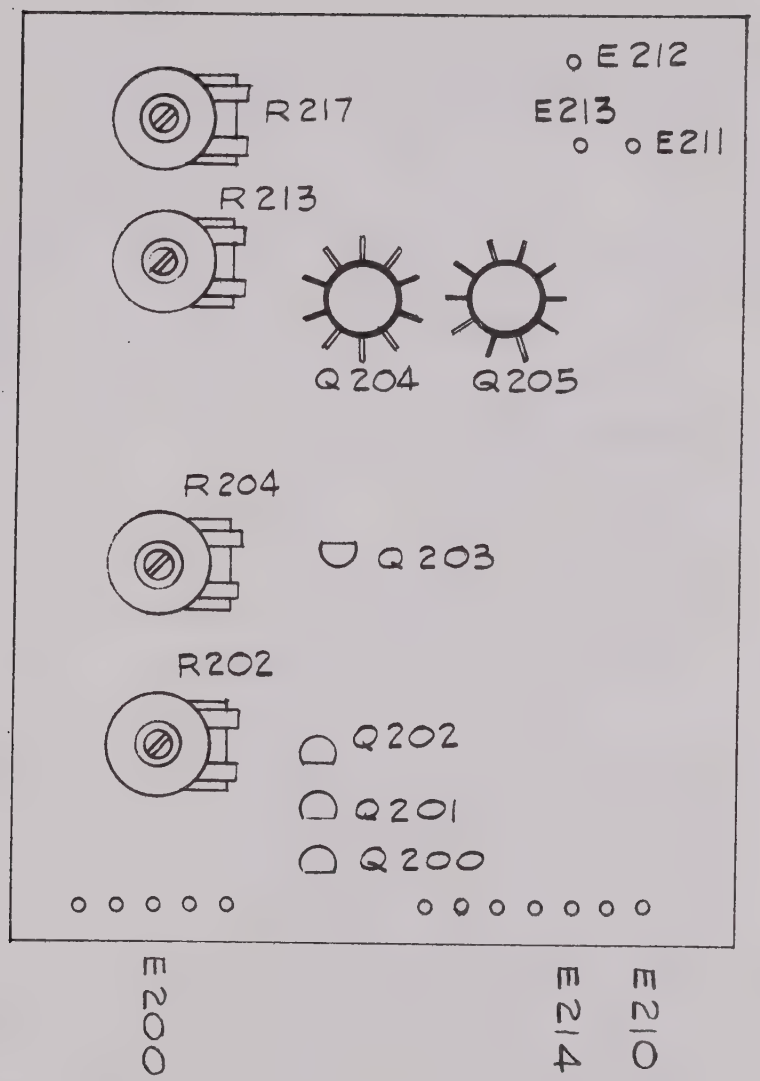


Figure 5-1. Horizontal Board A4

2. Connect the audio oscillator to the VERT IN jack (J1). Set the oscillator frequency to 45Hz.

3. Increase the audio oscillator gain control until the sine wave, as observed on the scope, is full scale.

4. Turn the SWEEP SPEED control (R5) full CCW. Turn the SWEEP RANGE switch to the "LO" position.

5. Adjust A4 - R204 to secure a one cycle stationary pattern.

6. After adjusting R204, it may be necessary to readjust A4 - R213 slightly to widen the trace to the width of the scope face.

7. Turn the SWEEP SPEED control full CW, turn the SWEEP RANGE switch to the "HI" position and increase the audio oscillator frequency to 5 kHz.

8. Adjust A4 - R202 to secure a one cycle stationary pattern.

9. Repeat steps #2 thru #8 until no further adjustment is needed.

10. Leave the SWEEP RANGE switch in the "HI" position and turn the SWEEP SPEED control full CCW.

11. Adjust the audio oscillator for a one cycle stationary pattern. The frequency required for this condition should be less than 500 Hz. Approximately 450 Hz.

12. Set the SWEEP RANGE switch to the "LO" position and turn the SWEEP SPEED control full CW.

13. Adjust the audio oscillator frequency for a one cycle stationary pattern. The frequency required for this condition should be more than 500 Hz. Approximately 550 Hz.

5.5.2 Vertical Amplifier (Board A3, Figure 5-2)

A. Vertical Positioning Adjustment

1. Turn the VERT MODE switch (S2) to the "VERT SET" position.

2. Set the vertical position control (R6) to mid-range.

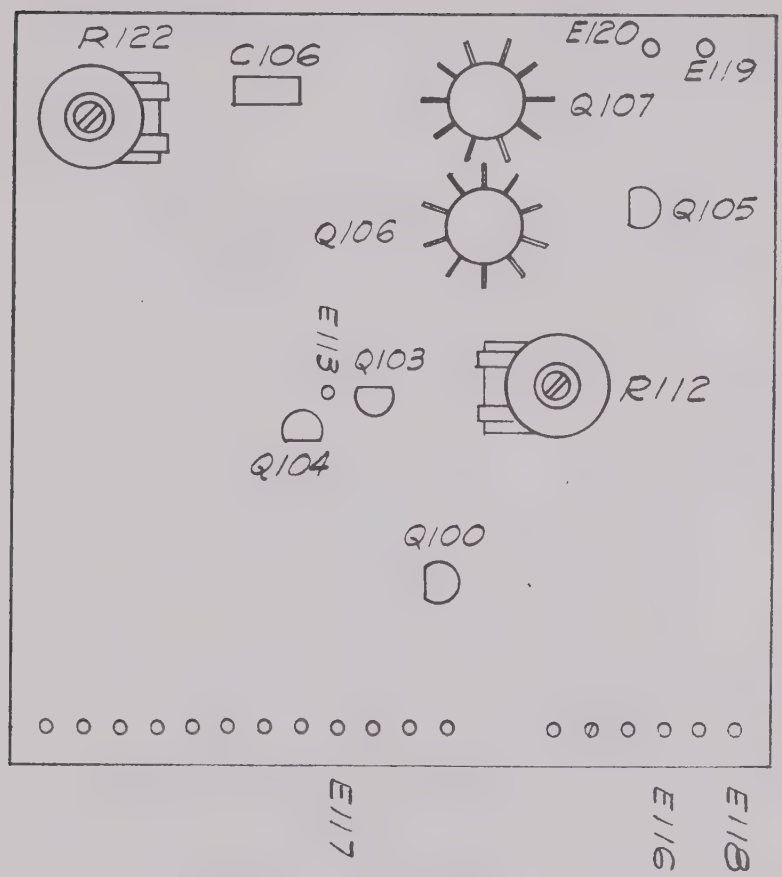


Figure 5-2. Vertical Board A3

3. Adjust A3 - R112 so that the trace is positioned on the center line of the scope graticule.

B. Amplitude Adjustment

1. Connect the audio oscillator to the AC VTVM and to the vertical input jack (J1); set the frequency for 1 kHz and the amplitude output for 0.1 volts rms.

2. Turn the VERT MODE switch to the "EXT" position, and the VERT GAIN control full CW.

3. Adjust A3 - R122 (GAIN SET) for full scale deflection on the scope.

5.5.3 AM Detector (Board A1, Figure 5-3)

A. IF Alignment

1. Connect the OAM-1 to the FM-10 with the extender cable.

2. On the FM-10: Set the frequency to 2 MHz, 10 MHz switch "OUT", and Audio switch "OUT".

   On the FM-10C: Set the frequency to 000000 and the MODE switch to "MEAS" position.

3. Connect the oscilloscope probe between TP601 on the AM detector board (A1) and ground, set the oscilloscope gain as necessary to observe the IF signal.

4. Adjust A1 - L601, L602, and L603 for maximum peak-to-peak amplitude on the oscilloscope.

5. Set the A1 - R641 trimpot to mid-range and connect the oscilloscope probe across A1 - R626 (1K ohms).

6. Adjust A1 - L606 for maximum deflection on the oscilloscope, Readjust A1 - L601, L602, L603, and L606 for maximum output. Disconnect the oscilloscope probe.

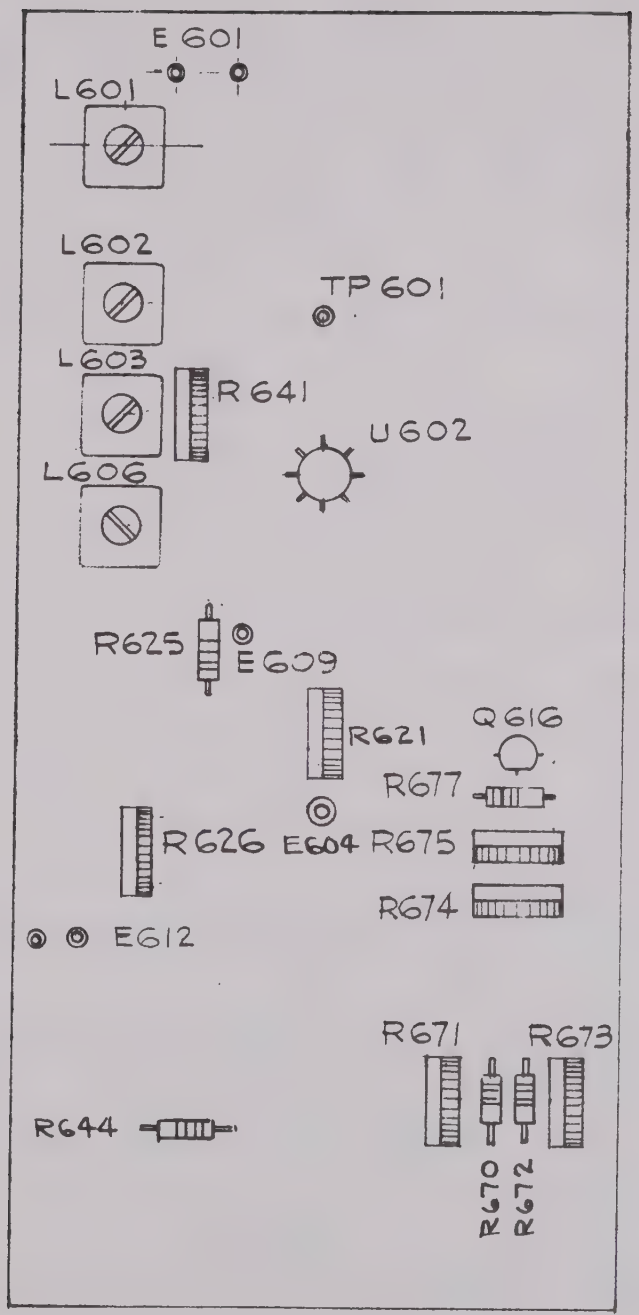


Figure 5-3. AM Detector Board A1

B. Detector Offset Adjustment

1. a. Connect an aligator clip between A1 - E601 and ground.
   b. Release 10 MHz button on FM-10. On FM-10C set Mode to "GEN".
2. Set the VERT MODE switch (S2) to the "VERT SET" position and adjust the VERT POS control (R6) so the OAM-1 scope trace is exactly on the "VERTICAL SET" line.
3. Set the VERT MODE switch to the "CARR SET" position and adjust A1 - R626 trimpot so that the scope trace is exactly on the "VERTICAL SET" line.
4. Repeat Steps 2 and 3.
5. Remove the jumper lead installed in Step 1.

C. IF Dynamic Range Adjustment

1. Connect the HP606A Signal Generator to the FM-10 MEAS INPUT jack.
2. Set the HP606A frequency to 60 MHz, and output level to 6 millivolts (CW).
3. On the FM-10: Set the frequency to 63 MHz.
   On the FM-10C: Set the frequency to 61 MHz and the MODE switch to "MEAS" position.
4. On the OAM-1: Set the VERT MODE switch (S2) to the "VERT SET" position and adjust the VERT POS control (R6) so that the scope trace is exactly on the "VERTICAL SET" line. Set the "CARRIER LEVEL" control (R1) to maximum CW.
5. Set the VERT MODE switch to the "CARR SET" position and adjust HP606A frequency vernier for maximum upward deflection of the scope trace.
6. Adjust A1 - R641 trimpot so that the scope trace is exactly on the "CARRIER SET" line of the scope graticule.

7. Repeat Steps 4, 5, and 6.

8. Set the CARRIER LEVEL control full CCW and increase the HP606A output level until the scope trace is exactly on the CARRIER SET LINE. The 606A Output Level should be between 16 and 20 mV, if not, adjust 606A to 18 mV and adjust R621 for CARRIER SET LINE.

9. Repeat Steps 4 thru 8.

10. Adjust the HP606A output level to 6 millivolts and set the carrier level control full CW.

11. Set the VERT MODE switch to the "MEAS AM" position. The trace on the scope should be exactly on the "0" center line of the graticule. There may be noise on the trace, but it should have equal amplitude above and below the "0" center line.

12. If the trace is offset from the "0" center line, repeat Steps B1 thru C11.

D. MODULATION MEASUREMENT ACCURACY. SET SIG GEN TO TO 10 MHz.

1. Set the RANGE switch (S3) to the "30%" position. Connect the HP200CD Audio Oscillator to both the HP606A Ext. Modulation input jack, and the Oscilloscope Ext. Horizontal Input jack. Set the HP200CD frequency to 1 kHz and its output level to approximately 8V p-p. Set the HP606A Modulation Selector switch to the EXT. position and adjust the Modulation Level control so that the waveform on the OAM-1 CRT is deflected exactly full scale (30% modulation).

2. Disconnect the cable from the FM-10 MEAS INPUT jack and connect it to the Oscilloscope Vertical Input jack. Adjust the Vertical and External Horizontal controls to obtain a trapozoid pattern whose width is approximately 5 cm and whose E max amplitude is exactly 4 cm. E min amplitude should be within 2.3 to 2.0 cm (27 to 33% modulation).

3. Disconnect the cable from the Oscilloscope Vertical Input jack and connect it to the FM-10 MEAS INPUT jack. Set the RANGE switch (S3) to the 100% position. Increase the HP606A Modulation Level control so that the waveform on the OAM-1 CRT is deflected exactly 80%.

4. Disconnect the cable from the FM-10 MEAS INPUT jack and connect it to the Oscilloscope Vertical Input jack. Adjust the Oscilloscope controls so that E max amplitude is exactly 4 cm. E min amplitude should be within 0.65 to 0.25 cm (72 to 88% modulation).

5. Disconnect the cable from the Oscilloscope Vertical Input jack and connect it to the FM-10 MEAS INPUT jack. Increase the HP606A Modulation Level control so that the waveform on the OAM-1 CRT is deflected 95%. The waveform should be symmetrical above and below the "0" center line and no clipping of the peak should be evident. Increase the HP606A Modulation Level control further, and the peaks should begin clipping as you approach or exceed 100% modulation.

E. Modulation Oscillator Alignment

1. Connect the AC VTVM and the frequency counter to the AUDIO OUT 600Ω jack (J3). Connect a 600 ohm load (resistor) across the AC VTVM input.

2. Turn the INT MOD/AUDIO OUT control (R2) full CW (max. output).

3. Set the MOD/AUDIO OUT FREQ switch (S5) to the "1 kHz" position.

4. Adjust A1 - R674 for a 1 volt rms ±3 dB indication on the AC VTVM.

5. Adjust A1 - R671 for a 1 kHz ±30 Hz reading on the counter (readjust A1 - R674 if necessary for 1 volt output).

6. Set the MOD/AUDIO OUT FREQ switch to the "400 Hz" position.

7. Adjust A1 - R675 for a 1 volt rms ±3 dB indication on the AC VTVM.

8. Adjust A1 - R673 for a 400 Hz ± 12 Hz reading on the counter. (Readjust A1 - R675 if necessary for 1 volt output).

9. Connect the AUDIO OUT 600 Ω jack to the distortion and analyzer.

10. Read distortion of the audio output. Should be less than 1%.

11. Set the MOD/AUDIO OUT FREQ switch to the "1 kHz" position and repeat Steps 9 and 10.

F. Modulation Ammplifier Adjustment

1. On the FM-10: Set the frequency to 12 MHz and push the 10 MHz switch to the "IN" position.

   On the FM-10C: Set the MODE switch to "GEN MOD CAL" position.

2. Set the VERT MODE switch (S2) to the "VERT SET" position and adjust the VERT POS control so the trace is exactly on the "VERTICAL SET" line.

3. Set the VERT MODE switch to the "CARR SET" position and adjust the CARRIER LEVEL control (R1) so that the scope trace is exactly on the "CARRIER SET" line.

4. Set the VERT MODE switch to the "MEAS AM" position and verify that INT MOD/AUDIO OUT control (R2) is full CW.

5. Set the range switch (S3) to the "FM-10 30%" position.

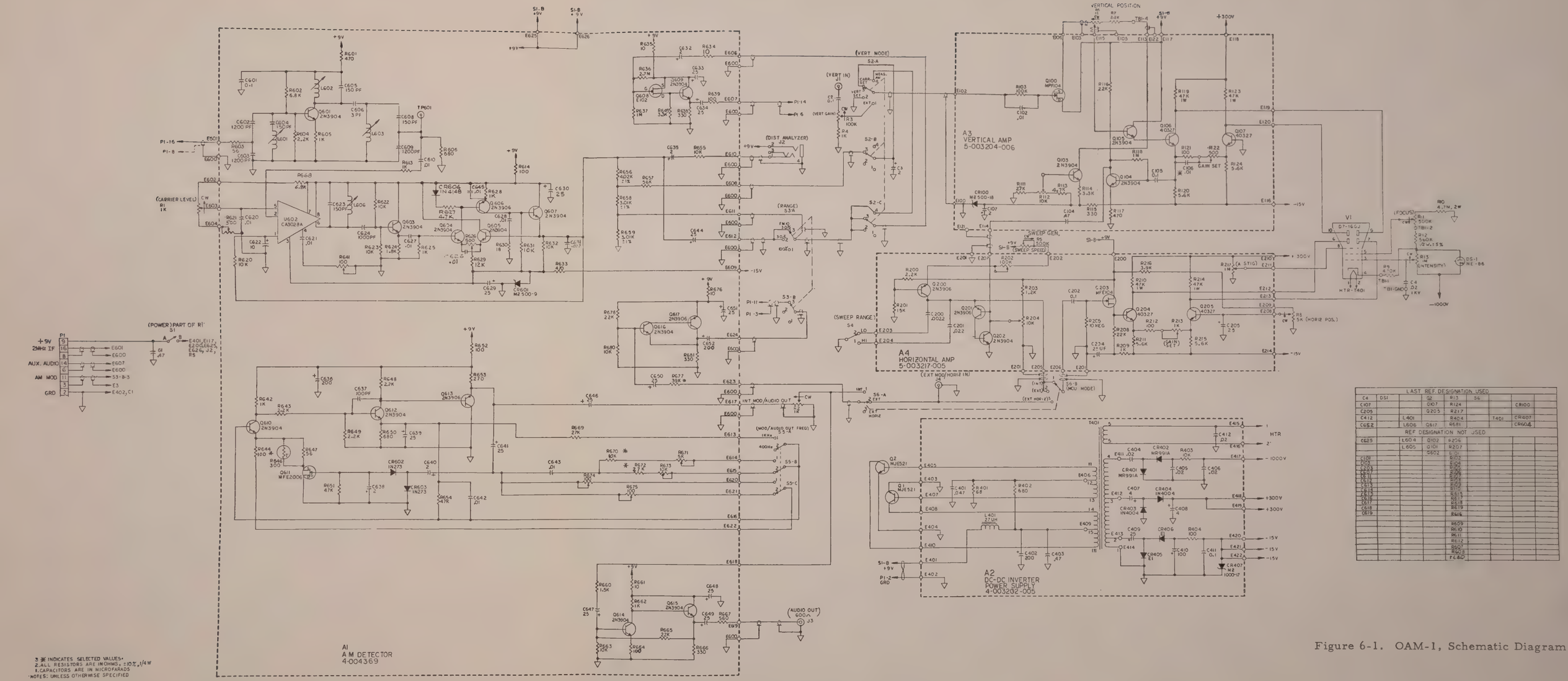
6. The signal of E624 should be between 60 and 70 mVrms into a 10 ohm load.

7. If the signal is less than 60 mVrms reduce A1-R677, if the signal is greater than 70 mVrms increase A1-R677.

8. Set the MOD MODE switch (S6) to the "EXT" position. Connect the EXT MOD/HORIZ IN jack (J4) to the AUDIO OUT 600 Ω jack (J3) and verify that modulation appears on the scope and that it changes amplitude when the INT MOD/AUDIO OUT control is turned.

SECTION VI

SCHEMATIC DIAGRAM



LAST REF. DESIGNATION USED							
C4	DS1		Q2	R13	S6		
C107			Q107	R124			CR100
C205			Q205	R217			
C412		L401		R404		T401	CR407
C652		L606	Q617	R681			CR604
REF DESIGNATION NOT USED							
C625		L604	Q102	R206			
		L605	Q101	R207			
			Q202	R208			
C101				R209			
C201				R210			
C203				R211			
C611				R213			
C613				R214			
C615				R215			
C616				R615			
C617				R617			
C618				R618			
C619				R619			
				R646			
				R659			
				R610			
				R611			
				R612			
				R607			
				R608			
				FC40			

Figure 6-1. OAM-1, Schematic Diagram

3. ✱ INDICATES SELECTED VALUES.
2. ALL RESISTORS ARE IN OHMS, ±10%, 1/4W
1. CAPACITORS ARE IN MICROFARADS
NOTES: UNLESS OTHERWISE SPECIFIED

SECTION VII

PARTS LIST

OAM-1 MAIN ASSEMBLY

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
A1	AM Detector Board Assembly	4-004369-005	Singer		1
A2	H. V. Power Supply Board Assembly	4-003202-005	Singer		1
A3	Vertical Amplifier Board Assembly	5-003204-006	Singer		1
A4	Horizontal Amplifier Board Assembly	5-003217-005	Singer		1
C1	Capacitor, Metalized Plastic 20%, 250 vdc, 0.47μF	1-900001-021	Amperex	Type C280AE	1
C4	Capacitor, Ceramic disc, 20%, 1000 vdc 0.02 μF	1-900012-012	Sprague	5QA-S20	1
DS1	Lamp, neon	1-925008-011	G. E.	Type NE-86	1
P1	Connector, plug	1-910071-001	Amphenol	26-159-16	1
Q1, Q2	Transistor, Silicon NPN	1-958001-004	Motorola	MJE 521	2
R6, R13	Resistor, variable, concentric ±30%	1-003215-002	Chicago Tele Supply	Type C2-45	2
R7	Resistor, carbon, 1/4W, 10% 2.2K	1-945000-041	Allen-Bradley	Type CB	1
R8, R11	Resistor, variable, concentric ±30%	1-003215-001	Chicago Tele Supply	Type C2-45	2
R9	Resistor, carbon 1/4W, 10% 470K	1-945000-069	Allen-Bradley	Type CB	1
R10	Resistor, carbon 2W, 10% 4.7M	1-945003-081	Allen-Bradley	Type HB	1
R12	Resistor, carbon 1/2W, 5% 560K	1-945001-228	Allen-Bradley	Type EB	1
S3, R1	Switch/Pot concentric	1-003210-003	Chicago Tele Supply	Type C212/45	1
S4/R5	Switch/Pot concentric	1-003210-002	Chicago Tele Supply	Type C212/45	1
V1	Cathode Ray tube	1-917000-001	Telefunken	Type D7-16GJ	1

OAM-1 FRONT PANEL ASSEMBLY

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
C2	Capacitor, metalized plastic 20%, 250 vdc 0.1 μF	1-900001-013	Amperex	Type C280AE	1
C3	Capacitor, Elect, 25 vdc, 2 μF	1-900023-016	Sprague	TE1201	1
J1	Connector, BNC	1-910132-001	Gremar	Type UG-1094A/U	1
J2	Littel Jax	1-910152-001	Switchcraft	S-138	1
J3, J4	Connector, BNC	1-910132-001	Gremar	Type UG-1094A/U	2
R4	Resistor, carbon 1/4W, 10% 1K	1-945000-037	Allen-Bradley	Type CB	1
S1, S6, R2	Switch/Pot, concentric	1-003407-003	Chicago Tele Supply	Type 212/45	1
S2, R3	Switch/Pot concentric	1-003407-001	Chicago Tele Supply	Type C212/45	1
S5	Switch, Rotary	1-003214-003	Chicago Tele Supply	Type 223	1

OAM-1 AM DETECTOR BOARD A1

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
C601	Capacitor, metalized plastic 20%, 250 vdc 0.1 μF	1-900001-013	Amperex	C280AE	1
C602, 603	Capacitor, mica 5%, 100 vdc 1200 pF	1-900003-057	Electro Motive Mfg	DM-15	2
C604, 605	Capacitor, mica 5%, 500 vdc 150 pF	1-900003-034	Electro Motive Mfg	DM-15	2
C606	Capacitor, mica 3 ±.5 pF, 500 vdc 3 pF	1-900003-003	Electro Motive Mfg	DM-15	1
C607	Not used				
C608	Same as C604				1
C609	Same as C602				1
C610, 645	Capacitor, metalized plastic 20%, 250 vdc 0.01 μF	1-900001-001	Amperex	C280AE	2
C611 thru 619	Not used				
C620, 621	Same as C610				2
C622	Capacitor, Elect, 25 vdc 10 μF	1-900023-017	Sprague	TE-1204	1
C623	Same as C604				1
C624	Capacitor, mica 5%, 100 vdc 1000 pF	1-900003-056	Electro Motive Mfg	DM-15	1

OAM-1 AM DETECTOR BOARD A1 (Continued)

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
C625	Not used				
C626, 627, 628	Same as C610				3
C629, 630	Capacitor, elect 25 vdc 25 μF	1-900039-001	Gen. Inst. Corp	984-118	2
C631	Capacitor, metalized plastic 20%, 250 vdc .022 μF	1-900001-005	Amperex	C280AE	1
C632	Capacitor, elect. 25 vdc 2 μF	1-900023-016	Sprague	TE-1201	1
C633, 634	Same as C629				2
C635	Same as C632				1
C636, 652	Capacitor, elect 15 vdc 200 μF	1-900039-002	Gen. Inst. Corp	984-141	2
C637	Capacitor, mica 5% 500 vdc 100 pF	1-900003-030	Electro Motive Mfg	DM-15	1
C638	Same as C632				1
C639	Same as C629				1
C640	Same as C632				1
C641	Same as C629				1
C642, 643	Same as C610				2
C644	Same as C629				1
C646 thru C651	Same as C629				7
CR601	Diode, Zener 5% 400 mW 5.1v	1-913003-009	Motorola	MZ-500-9	1
CR602, 603	Diode, Germanium	1-913005-001	Transitron	IN273	2
CR604	Diode, Silicon	1-913007-001	Motorola	IN4148	1
L601, 602, 603	Inductor, variable 30 - 60 μH	1-906006-003	Precision Coil	L57-2CT F4	3
L604, 605	Not used				0
L606	Same as L601				1
Q601	Transistor, silicon NPN	1-958000-001	Motorola	2N3904-5	1
Q602	Not used				0
Q603, 604, 605	Same as Q601				3
Q606	Transistor, silicon PNP	1-958000-002	Motorola	2N3906-5	1
Q607	Same as Q601				1
Q608	Transistor, FET	1-958031-003	Siliconics	E102	1
Q609, 610	Same as Q601				2

OAM-1 AM DETECTOR BOARD A1 (Continued)

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
Q611	Transistor, FET	1-958044-003	Motorola	MFE2006	1
Q612	Same as Q601				1
Q613	Same as Q606				1
Q614, 615, 616	Same as Q601				3
Q617	Same as Q606				1
R601	Resistor, carbon, 1/4W, 10% 470Ω	1-945000-033	Allen-Bradley	CB	1
R602	Resistor, carbon, 1/4W, 10%, 6.8K	1-945000-047	Allen-Bradley	CB	1
R603	Resistor, carbon 1/4W, 10% 56Ω	1-945000-022	Allen-Bradley	CB	1
R604	Resistor, carbon 1/4W, 10% 2.2K	1-945000-041	Allen-Bradley	CB	1
R605	Resistor, carbon 1/4W, 10% 1K	1-945000-037	Allen-Bradley	CB	1
R606	Resistor, carbon 1/4W, 10% 680Ω	1-945000-035	Allen-Bradley	CB	1
R607 thru R612	Not used				0
R613	Same as R605				1
R614	Resistor, carbon, 1/4W, 10% 100Ω	1-945000-025	Allen-Bradley	CB	1
R615 thru R619	Not used				0
R620	Resistor, carbon 1/4W, 10% 10K	1-945000-049	Allen-Bradley	CB	1
R621	Resistor, variable ±30% 500Ω	1-945007-003	Chicago Tele Supply	X201	1
R622, 623	Same as R620				2
R624	Resistor, carbon, 1/4W, 10% 1.8K	1-945000-040	Allen-Bradley	CB	1
R625	Same as R605				1
R626	Same as R621				1
R627	Resistor, carbon, 1/4W, 10% 4.7K	1-945000-045	Allen-Bradley	CB	1
R628	Same as R605				1
R629	Resistor, carbon, 1/4W, 10%, 12K	1-945000-50	Allen-Bradley	CB	1
R630	Resistor, carbon, 1/4W, 10% 18Ω	1-945000-016	Allen-Bradley	CB	1

OAM-1 AM DETECTOR BOARD A1 (Continued)

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
R631	Same as R620				1
R632	Same as R620				1
R633	Same as R601				1
R634	Resistor, carbon, 1/4W, 10% 1.0M	1-945000-073	Allen-Bradley	CB	1
R635	Resistor, carbon, 1/4W, 10Ω	1-945000-013	Allen-Bradley	CB	1
R636	Resistor, carbon, 1/4W, 10% 2.7M	1-945000-078	Allen-Bradley	CB	1
R637	Same as R634				1
R638	Resistor, carbon, 1/4W, 10% 330Ω	1-945000-031	Allen-Bradley	CB	1
R639	Same as R614				1
R641	Resistor, Variable ±30% 100Ω	1-945007-001	Chicago Tele Supply	X201	1
R642	Same as R605				1
R643	Same as R604				1
R644	Resistor, Selected				1
R645	Resistor, carbon, 1/4W, 10% 3.3K	1-945000-043		CB	1
R646	Resistor, thermistor ±2% 300Ω	1-945070-001	Corning	C20	1
R647	Same as R603				1
R648, 649	Same as R604				2
R650	Same as R606				1
R651	Resistor, carbon, 1/4W, 10% 47K	1-945000-057	Allen-Bradley	CB	1
R652	Same as R614				1
R653	Resistor, carbon, 1/4W, 10% 270Ω	1-945000-030	Allen-Bradley	CB	1
R654	Same as R651				1
R655	Same as R620				1
R656	Resistor, film 1% 4.02K	1-945016-251	Amer. Compt.	RN60D	1
R657	Resistor, carbon 1/4W, 10% 56K	1-945000-058	Allen-Bradley	CB	1
R658, 659	Resistor, film 1% 3.01K	1-945016-239	Amer. Compt.	RN60D	2
R660	Resistor, carbon 1/4W, 10%, 1.5K	1-945000-039	Allen-Bradley	CB	1
R661	Same as R635				1

OAM-1 AM DETECTOR BOARD A1 (Continued)

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
R662	Same as R605				1
R663	Same as R620				1
R664	Same as R614				1
R665	Resistor, carbon, 1/4W, 10%, 22K	1-945000-053	Allen-Bradley	CB	1
R666	Same as R638				1
R667	Resistor, carbon, 1/4W, 10%, 560Ω	1-945000-034	Allen-Bradley	CB	1
R668	Same as R602				1
R669	Resistor, carbon, 1/4W, 10%, 27K	1-945000-054	Allen-Bradley	CB	1
R670	Resistor, selected				1
R671	Resistor, variable ±30% 5K	1-945007-006	Chicago Tele Supply	X201	1
R672	Resistor, selected				1
R673	Resistor, variable ±30% 10K	1-945007-007	Chicago Tele Supply	X201	1
R674, 675	Same as R641				2
R676	Same as R635				1
R677	Resistor, selected	1-945000-000	Allen-Bradley	CB	1
R678	Same as R665				1
R679	Not used				
R680	Same as R620				1
R681	Same as R638				1
U602	Integrated Circuit	1-926005-001	RCA	CA3028A	1

OAM-1 VERTICAL AMPLIFIER BOARD A3

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
C102	Capacitor, metalized plastic 20% 250 vdc 0.01 μF	1-900001-001	Amperex	C280AE	1
C103	Not used				0
C104	Capacitor, metalized plastic 20%, 250 vdc 0.47 μF	1-900001-021	Amperex	C280AE	1
C105, 106	Capacitor, metalized plastic 20%, 250 vdc 0.1 μF	1-900001-013	Amperex	C280AE	2
C107	Capacitor, elec. 25V, 2μF	1-900023-016	Sprague	TE-1201	1
CR100	Diode, Zener 5%, 400 mW 12V	1-913003-020	Motorola	MZ500-18	1
CR101, 102	Not used				0
Q100	Transistor, FET N-channel	1-958002-002	Motorola	MPF 104-5	1
Q101, 102	Not used				0
Q103, 104, 105	Transistor, silicon NPN	1-958000-001	Motorola	2N3904-5	3
Q106, 107	Transistor, silicon NPN	1-958004-001	RCA	40327	2
R103	Resistor, carbon 1/4W, 10% 100K	10945000-061	Allen-Bradley	CB	1
R104 thru R110	Not used				0
R111	Resistor, carbon 1/4W, 10% 27K	1-945000-054	Allen-Bradley	CB	1
R112	Resistor, Variable ±30% 10K	1-945010-007	Chicago Tele Supply	U201	1
R113	Resistor, carbon 1/4W, 10% 4.7K	1-945000-045	Allen-Bradley	CB	1
R114	Resistor, carbon 1/4W, 10% 3.3K	1-945000-043	Allen-Bradley	CB	1
R115	Resistor, carbon 1/4W, 10% 330Ω	1-945000-031	Allen-Bradley	CB	1
R116	Same as R111				1
R117	Resistor, carbon 1/4W, 10% 470Ω	1-945000-033	Allen-Bradley	CB	1
R118	Resistor, carbon 1/4W, 10% 1M	1-945000-073	Allen-Bradley	CB	1
R119	Resistor, carbon 1W, 10% 47K	1-945002-057	Allen-Bradley	CB	1
R120	Resistor, carbon 1/4W, 10% 5.6K	1-945000-046	Allen-Bradley	CB	1
R121	Resistor, carbon 1/4W, 10% 100Ω	1-945000-025	Allen-Bradley	CB	1

OAM-1 VERTICAL AMPLIFIER BOARD A3 (Continued)

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
R122	Resistor, variable ±30% 500Ω	1-945010-003	Chicago Tele Supply	U201	1
R123	Same as R119				1
R124	Same as R120				1

OAM-1 HORIZONTAL AMPLIFIER BOARD A4

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
C200	Capacitor, dipped plastic, non-inductive 10%, 400V 0.0022 μF	1-900005-101	Mallory	PVC	1
C201	Capacitor, dipped plastic, non-inductive 10%, 200 V 0.022 μF	1-900005-004	Mallory	PVC	1
C202	Capacitor, metalized plastic 20% 250 vdc 0.1 μF	1-900001-013	Amperex	C280AE	1
C203	Not used				0
C204, 205	Capacitor, elec, 35 vdc, 25 μF	1-900000-021	Wima	Printilyt	2
Q200, 201	Transistor, Silicon PNP	1-958000-002	Motorola	2N3906-5	2
Q202	Transistor, Silicon NPN	1-958000-001	Motorola	2N3904-5	1
Q203	Transistor, FET N-Channel	1-958002-002	Motorola	MPF 214-5	1
Q204, 205	Transistor, Silicon NPN	1-958004-001	RCA	40327	2
R200	Resistor, carbon 1/4W, 10% 2.2K	1-945000-041	Allen-Bradley	CB	1
R201	Resistor, carbon 1/4W, 10% 15K	1-945000-051	Allen-Bradley	CB	1
R202	Resistor, variable ±30% 100K	1-945010-010	Chicago Tele Supply	U201	1
R203	Resistor, carbon 1/4W, 10% 1.2K	1-945000-038	Allen-Bradley	CB	1
R204	Resistor, variable ±30% 10K	1-945010-007	Chicago Tele Supply	U201	1
R205	Resistor, carbon 1/4W, 10% 10M	1-945000-085	Allen-Bradley	CB	1
R208	Resistor, carbon 1/4W, 10% 22K	1-945000-053	Allen-Bradley	CB	1
R209	Resistor, carbon 1/4W, 10% 1K	1-945000-037	Allen-Bradley	CB	1
R210	Resistor, carbon 1W 10% 47K	1-945002-057	Allen-Bradley	CB	1

OAM-1 HORIZONTAL AMPLIFIER BOARD A4 (Continued)

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
R211	Resistor, carbon 1/4W, 10% 5.6K	1-945000-046	Allen-Bradley	CB	1
R212	Resistor, carbon 1/4W, 10% 100Ω	1-945000-025	Allen-Bradley	CB	1
R213	Resistor, variable ±30% 1K	1-945010-004	Chicago Tele Supply	U201	1
R214	Same as R210				1
R215	Same as R211				1
R216	Resistor, carbon 1/4W, 10% 3.9K	1-945000-044	Allen-Bradley	CB	1
R217	Resistor, variable ±30% 1M	1-945010-013	Chicago Tele Supply	U201	1

OAM-1 DC - DC INVERTER POWER SUPPLY A2

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
C401	Capacitor, metalized plastic 20%, 250 vdc 0.047 μF	1-900001-009	Amperex	C280AE	1
C402	Capacitor, elect, 15V 200 μF	1-900039-002	General Instr.	984-141	1
C403	Capacitor, metalized plastic 20% 250 vdc 0.47 μF	1-900001-021	Amperex	C280AE	1
C404, 405 406	Capacitor, ceramic disc, 20% 1000 vdc 0.02 μF	1-900012-012	Sprague	5GA-S20	3
C407, 408	Capacitor, elect, 350 vdc, 4 μF	1-900011-001	Cornell-Dubilier	BR	2
C409	Capacitor elect 35 vdc, 25 μF	1-90000-021	Wima	Printilyt	1
C410	Capacitor, elect. 25 vdc, 100 μF	1-900039-004	General Inst.	984-130	1
C411	Capacitor, ceramic disc, $^{+80}_{-20}$%, 500 vdc 0.1 μF	1-900012-005	Sprague	41C92	1
C412	Same as C404				1
CR401, 402	Diode, rectifier	1-913043-002	Motorola	MR991A	2
CR403, 404	Diode, Silicon	1-913001-004	Motorola	IN4004	2
CR405, 406	Diode, rectifier	1-913002-001	Sarkes Tarzian	E1	2
CR207	Diode, Zener 10% 1W 15V	1-913004-017	Motorola	MZ1000-17	1
L401	Inductor, filter 27 μH	1-003213-001	Singer		1

SYMBOL NUMBER	DESCRIPTION	SINGER PART NUMBER	MANUFACTURE NAME	MANUFACTURE PART NUMBER	QTY
R401	Resistor, carbon 1/4W, 10% 68Ω	1-945000-023	Allen-Bradley	CB	1
R402	Resistor, carbon 1/4W, 10% 680Ω	1-945000-035	Allen-Bradley	CB	1
R403	Resistor, carbon 1/4W, 10% 10K	1-945000-049	Allen-Bradley	CB	1
R404	Resistor, carbon 1/4W, 10% 100Ω	1-945000-025	Allen-Bradley	CB	1
T401	Transformer	1-003206-001	Singer		1

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CHANGE NOTICE SUMMARY

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